Stability of Multi-Planet Systems in the Alpha Centauri System

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Abstract

We evaluate the extent of the regions within the alpha Centauri AB star system where small planets are able to orbit for billion-year timescales (Quarles & Lissauer 2016, Astron. J. 151, 111), as well as how closely-spaced planetary orbits can be within those regions in which individual planets can survive.Although individual planets on low inclination, low eccentricity, orbits can survive throughout the habitable zones of both stars, perturbations from the companion star imply that the spacing of planets in multi-planet systems within the habitable zones of each star must be significantly larger than the spacing of similar multi-planet systems orbiting single stars in order to be long-lived.Because the binary companion induces a forced eccentricity upon the orbits of planets in orbit around either star, appropriately-aligned circumstellar orbits with small initial eccentricities are stable to slightly larger initial semimajor axes than are initially circular orbits.Initial eccentricities close to forced eccentricities can have a much larger affect on how closely planetary orbits can be spaced, and therefore on how many planets may remain in the habitable zones, although the required spacing remains significantly higher than for planets orbiting single stars.